

GP-301468

5 IMAGE SENSOR METHOD AND APPARATUS HAVING
ADDRESSABLE PIXELS AND NON-DESTRUCTIVE READOUT

ABSTRACT OF THE DISCLOSURE

10 An image sensor having an array of pixel elements constructed using a two
level polysilicon CMOS process that provides individual addressability and a non-
destructive readout of the pixels. The pixel elements each includes a substrate, an
15 insulating layer formed on the substrate, a collection capacitor electrode, a transfer
electrode, a readout capacitor electrode, and a readout transistor. The transfer
electrode is located between the collection and readout capacitor electrodes and all
three electrodes are electrically isolated from the substrate and each other by the
20 insulating layer. The collection capacitor electrode and insulating layer are
transparent so that incident light can pass through these elements and be absorbed by
the substrate. A bias voltage is applied to the collection electrode to form a depletion
region in the substrate where photoelectrically generated charge is collected. The
charge is then transferred to a second depletion region underneath the readout
25 capacitor electrode by applying a bias voltage to the transfer electrode. The readout
transistor has an insulated gate connected to the readout capacitor electrode, so that it
can generate a pixel data output signal indicative of the charge that is now stored
under the readout capacitor electrode. This reading out of the pixel data is therefore
non-destructive, allowing the pixel to be read multiple times without loss of
30 information. An image sensor so constructed can be used in conjunction with on-chip
image processing circuits for performing such tasks as edge detection and other
algorithms that involve convolutions or other combinations of pixel data.

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